Open-charm meson spectroscopy

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The discovery of several new charmed mesons has reopen the interest in heavy meson spectroscopy. Two years ago BABAR Collaboration reported the observation of a charm-strange state, the $D_{sJ}^*(2317)$ [1]. Besides, BABAR had also pointed out to the existence of another charm-strange meson, the $D_{sJ}(2460)$ [1]. This resonance was measured by CLEO Collaboration [2] and confirmed by Belle Collaboration [3]. Belle results [3] are consistent with the spin-parity assignments of $J^P = 0^+$ for the $D_{sJ}^*(2317)$ and $J^P = 1^+$ for the $D_{sJ}(2460)$. Although these two states are definitively well established and confirmed independently by different experiments, they present unexpected properties. In particular, their energies and decay widths are quite different from those expected from quark potential models [4].

The intriguing situation of the charm-strange mesons has been translated to the non-strange sector with the Belle observation [5] of a nonstrange broad scalar resonance, $D_0^*(2308)$, whose properties also differ significantly from the predictions of quark potential models. A state with similar properties has also been suggested by FOCUS Collaboration [6].

The difficulties to identify the D_J and D_{sJ} states with conventional $c\bar{q}$ mesons has been related to those appearing in the light-scalar meson sector [7]. Therefore, it may indicate that other configurations, as could be for example four-quark contributions, could be playing a role. This has been shown as a possible interpretation of the low-lying light-scalar mesons, where the coupling of the scalar $q\overline{q}$ nonet to the lightest $qq\bar{q}\bar{q}$ configurations allows for an almost one-to-one correspondence between theoretical states and experiment [8]. In this contribution we present a description of the positive parity open-charm mesons in terms of two- and four-quark configurations, being their mixing the responsible for the unexpected low mass and/or width of the $D_{sJ}^*(2317)$, $D_{sJ}(2460)$, and $D_0^*(2308)$. The electromagnetic decay widths of these states are analyzed within our model. For this purpose the $q\bar{q} \to q\bar{q}+\gamma$, $qq\bar{q}\bar{q} \to q\bar{q} + \gamma$, and $qq\bar{q}\bar{q} \to qq\bar{q}\bar{q} + \gamma$ proceses are studied. This observable gives hints that would help in distinguishing the nature of these states. In particular, in agreement with other approaches [9], a discrepancy with the pure $q\bar{q}$ scheme is found for the ratio $D_{sJ}(2460) \to D_s^+\gamma / D_{sJ}(2460) \to D_s^{*+}\gamma$ [7].

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